AIDS and Behavior (2022) 26:3337–3344
https://doi.org/10.1007/s10461-022-03637-1

ORIGINAL PAPER

The Long-term (5-year) Impact of a Family Economic Empowerment Intervention on Adolescents Living with HIV in Uganda: Analysis of Longitudinal Data from a Cluster Randomized Controlled Trial from the Suubi+Adherence Study (2012–2018)

Rachel Brathwaite[1] · Fred M. Ssewamala[1,8] · Massy Mutumba[2] · Torsten B. Neilands[3] · William Byansi[1] · Flavia Namuwonge[4] · Christopher Damulira[1] · Proscovia Nabunya[1] · Gertrude Nakigozi[5] · Fredrick Makumbi[6] · Claude A. Mellins[7] · Mary M. McKay[8] · Suubi+Adherence Field Team[1]

Accepted: 18 February 2022 / Published online: 16 April 2022

Abstract
150/150 words.

We examined the 5-year impact of an economic empowerment (EE) intervention on: adherence, viral suppression, sexual risk-taking intentions (primary); and physical health, educational and economic (secondary) outcomes among adolescents living with HIV in Uganda. The Suubi + Adherence study (2012–2018) randomized clinics to: (1) Control group, n = 19 clinics, n = 344 participants; (2) intervention group which received matched savings accounts, mentorship, financial management and, business development training, n = 20 clinics, n = 358 participants. Participants completed post-baseline assessments at 12-, 24-, 36-, and 48-months. No significant differences in viral load, sexual risk-intentions and physical health perception were observed. The intervention group had better adherence (at 24-months) (Contrast=-0.28; 95% CI: -0.55, -0.004), higher school enrolment (OR = 2.18; 95% CI:1.30, 3.66); reported savings OR = 2.03 (1.29, 3.18) and higher savings (Contrast = 0.40; 95% CI:0.10, 0.70) than controls at 48-months. The EE intervention was efficacious in improving adherence, school enrolment, and economic outcomes creating opportunities for improved overall health among adolescents living with HIV.

Keywords Economic interventions · Adolescents living with HIV · Sub-saharan Africa

Introduction

Adolescents in low- and middle-income countries (LMICs) are disproportionately affected by the HIV/AIDS epidemic. Approximately 9 out of 10 (88%) adolescents living with HIV (ALWHIV) worldwide resided in the low-resource region of sub-Saharan Africa (SSA) in 2019 (1). Uganda is one of the countries in SSA with a high burden of HIV

ClinicalTrials.gov registration no: NCT01790373 on February 13, 2013.

✉ Fred M. Ssewamala
fms1@wustl.edu

1 International Center for Child Health and Development, Brown School, Washington University in St. Louis, 63130 St. Louis, MO, USA

2 Department of Health Behavior and Biological Sciences, School of Nursing, University of Michigan, Ann Arbor, MI, USA

3 Division of Prevention Science, Department of Medicine, University of California, San Francisco, CA, USA

4 International Center for Child Health and Development, Masaka, Uganda

5 Rakai Health Sciences Program, Kalisizo, Uganda

6 College of Health Sciences, Makerere University, Kampala, Uganda

7 HIV Center for Clinical and Behavioral Studies, New York State Psychiatric Institute and Columbia University Medical Center, New York, NY, USA

8 Brown School, Washington University in St. Louis, 63130 St. Louis, MO, USA

among children and adolescents (2). In 2019, there were approximately 5,700 new infections and 4,800 deaths among children aged 0–14 years (3). ALWHIV in low-resource environments such as Uganda require additional support and tailored interventions to help them overcome the numerous poverty-related barriers that hinder access to care, adherence to antiretroviral therapy (ART), maintenance of viral suppression, and achievement of overall better quality of life, inclusive of better physical and mental health, and positive social and economic outcomes.

ALWHIV in poverty-impacted environments are less likely to achieve the recommended levels of adherence to ART (4, 5), but most interventions targeting ART adherence among ALWHIV seldom focus on attempts to alleviate poverty (6, 7). Poverty is a substantial barrier that is associated with suboptimal health, limited access to healthcare and social services, food insecurity, and inconsistent and poor ART adherence (8, 9). Poverty is also associated with the worsening of mental health problems and increased engagement in risk-taking behaviors, including sexual risk-taking, increased vulnerability to abuse, as well as poor overall social, educational and economic outcomes (8, 9). Research shows that family-based economic empowerment (FEE) interventions that address poverty-related barriers to health can improve HIV care outcomes (10) and have positive effects on economic wellbeing (11) and psychological wellbeing among ALWHIV (12). However, the long-term effects of FEE interventions on HIV outcomes such as adherence and economic wellbeing remains understudied. To address the existing gaps and evaluate the long-term impact of FEE interventions on ALWHIV's overall health and wellbeing, we draw on five waves of data from baseline to 48 months. The Suubi + Adherence study is a 5-year prospective FEE study conducted among ALWHIV in Uganda. More specifically, we examine the long-term (5-year) impact of the Suubi + Adherence study on ART adherence, viral suppression, sexual risk-taking intentions, and self-rated physical health (primary outcomes), and educational and economic outcomes (secondary outcomes) among ALWHIV in Uganda.

Methods

Data

We utilize longitudinal data from the 'Suubi + Adherence study' (2012 to 2018), a two-arm cluster-randomized controlled trial conducted in Southwestern Uganda (10). This study was designed to test the impact of a FEE intervention designed to improve ART adherence among ALWHIV residing in the greater Masaka region of Southwestern Uganda (10), an area which experienced a substantially greater HIV prevalence compared to the HIV prevalence observed nationally (13–15). Suubi + Adherence is grounded in Asset theory (16), which postulates that ownership of assets improves developmental, psychological and social outcomes for individuals. Thus, for ALWHIV, Asset theory suggests that underprivileged adolescents, due to lack of resources, are more likely to believe they are unable to financially manage the costs associated with accessing and maintaining long-term care for HIV. Hence, these adolescents are less likely to be concerned about initiating and engaging in care, including adherence to ART, resulting in poorer physical and mental health outcomes. Additionally, they may be more likely to engage in risk-taking behaviors, including sexual risk-taking, which can result in poorer quality of life. On the other hand, an adolescent who owns assets and has access to resources is more likely to have a higher degree of hopefulness about the future and have better self-efficacy and thus engage in more positive health behaviors (including better ART adherence), which leads to improved viral suppression, reduced engagement in sexual risk-taking behaviors, improved physical health and improved mental health (17), as well as better social and economic outcomes and better quality of life.

Study design and setting

Adolescents were recruited from 39 health clinics located across six geographical districts (Masaka, Kalungu, Lwengo, Rakai, Kyotera and Bukomansimbi) of the greater Masaka region in Southwestern Uganda. Eligibility criteria for the clinics included: (1) had existing procedures tailored to adolescent adherence including adolescent clinic days and peer counseling; and (2) accredited by the Ugandan Ministry of Health as a provider of ART within the study districts. One clinic was excluded, after not meeting the inclusion criteria, resulting in 39 clinics included in the study. Eligibility criteria for adolescents included: (1) medically diagnosed with HIV and aware of their status; (2) living within a family setting (either biological or caregiver, but not within an institution); (3) aged 10–16 at baseline; (4) prescribed ART medication and; (5) receiving HIV care and treatment at one of the 39 clinics participating in the study. To avoid contamination, adolescents were randomly assigned at the clinic level to one of two groups: (1) control group which received bolstered standard of care (BSOC) which comprised medical and psychosocial support or; (2) family economic empowerment intervention group. In addition to BSOC, adolescents in the intervention group received child development savings accounts (for long-term savings), training on financial management and starting a business, and mentorship. Randomization of

clinics was done by an independent Columbia University Research Assistant. Participants in the control group did not know what the intervention group received. A total of 702 adolescents were recruited at baseline and participants completed repeated assessments at 12-, 24-, 36-, and 48-months post-baseline assessment.

Outcome Measures

We investigated the effect of the intervention on primary (adherence, HIV viral load, and sexual risk-taking intentions) and secondary (perception of physical health, school enrolment, any savings, and amount of savings) outcomes.

Primary outcomes: *Adherence*: Adherence was measured via self-reports. At each assessment, participants were asked the question *"In the last 30 days, on how many days did you miss at least one dose of your HIV medication?"* This was treated as a continuous variable, with lower values representing better adherence. *HIV RNA Viral load*: Participants provided blood samples to be tested for HIV RNA Viral load at each data collection time point, which were analyzed using the Abbott RealTime HIV-1 RNA Assay PCR (version 5.00) to quantify participants' plasma viral load. In accordance with the World Health Organization (WHO) guidelines (18), we used a cut off value of < 1000 copies/ml to categorize participants as virally suppressed or not virally suppressed (≥ 1000 copies/ml) (a binary variable). *Sexual risk-taking intentions*: A continuous summated score of 5 items was used to assess participants' sexual risk-taking intentions, with higher scores indicating higher agreement with sexual risk-taking (19). The 5 items included: (1) *'I believe it's ok for people my age to have sex with someone they've just met'; (2) 'I believe it's ok for people my age to have sex with someone they love'; (3) 'I believe it's ok for people to have sex before marriage'; (4) 'I agree it's ok to force a girlfriend/boyfriend to have sex even when they don't want to'; (5) 'I believe it's ok to have sex without protection with someone you know'.* Response options for each item included: Never = 1, Sometimes = 2, About half the time = 3, Most of the time = 4, or Always = 5.

Secondary outcomes: *Perception of physical health*: Adolescents were asked to rate their perception of their physical health on a 5-point scale ranging from 1 = very poor to 5 = excellent. *Savings*: Adolescents were asked whether they had any money saved anywhere (yes or no). For adolescents who reported having savings, they were asked about the amount of money they had saved. Due to the skewed nature of the Savings amount variable, this variable was log transformed. *School enrolment*: Adolescents were asked whether they were currently enrolled in school (yes or no).

Statistical analysis

All analyses were conducted in Stata version 16.1. Summary statistics for all outcomes by study group were computed at each time point. Continuous outcomes were summarized using means and standard deviations (SD) and categorical outcomes summarized using counts and percentages. We ran diagnostic tests to check the distribution of the residuals of the continuous outcomes for non-normality and/or inequality of residuals over levels of predicted values for linear mixed models by predicting standardized residuals after each linear mixed model. For each continuous outcome, we visually inspected the histogram of the standardized residuals with normal curve overlaid and a scatterplot of the standardized residuals by predicted values. We fitted three-level mixed-effects models for each outcome. For continuous outcomes, each model contained the outcome along with fixed categorical effects for study group (intervention vs. control), time (baseline, 12-, 24-, 36-, 48-months), a group-by-time interaction term, and a random intercept at the clinic level. We fitted an unstructured residual-error covariance matrix of the residuals from the repeated assessments taken on the same subjects and relaxed the assumption of equal variances and covariances across groups. For categorical outcomes, each model comprised the outcome, fixed categorical effects for study group, time, a group-by-time interaction term, and random intercepts at the clinic level and person level. Robust Huber-White standard errors and test statistics were used for all models. For each model, we evaluated: (a) omnibus effects for study group, time, and their interaction and (b) group comparisons within each time point for all outcomes irrespective of significance of the group-by-time effects using the *contrast* command. Margins plots are presented for all outcomes to help describe the patterns of results observed.

Sample size estimation

Details of the sample size and power analysis have been published in the protocol paper (10).

Results

Description of sample at baseline

A total of 702 ALWHIV were enrolled in the Suubi + Adherence study at baseline; 344 adolescents were randomly assigned at the clinic level to the control group, while 358 were randomly assigned to the FEE-intervention group (see Figure S1, CONSORT diagram). The mean age was 12 years, 56% were females, and almost two-thirds were

orphans, including 37% single orphans and 27% double orphans **(Table S1)**. Most adolescents (46%) reported their primary caregiver as either their biological father or mother, while 27% were primarily being cared for by a grandparent. Only 11% of the primary caregivers were formally employed. The retention rate at 48-months follow-up was 93.4%. Summary statistics for the outcomes at each time point by group are presented in **Table S2**.

Effect of the family economic intervention on ALWHIV's self-reported adherence, viral load, and sexual risk-taking intentions (Primary outcomes)

For the primary outcomes, only significant effects for time were observed overall **(Table S3)**. Specifically, time effects were observed for self-reported adherence ($\chi2(4) = 11.34$, $p = 0.0230$), detectable viral load ($\chi2(4) = 29.89$, $p < 0.0001$), and sexual risk-taking intentions ($\chi2(4) = 123.37$, $p < 0.0001$). There were no significant effects for group, and group-by-time interactions (**Table S3**). However, self-reported adherence differed significantly only at 24-months. The intervention group missed significantly fewer days of medication than ALWHIV in the control group (Contrast=-0.28 with a 95% confidence interval of -0.55, -0.004). For viral load, and sexual risk-taking intentions, there were no significant differences between the intervention and control group at 12-, 24-, 36-, and 48-months (Table 1).

Table 1 Comparisons of study group means within each time point for primary outcomes (group-within-time simple effects)

Time point	Comparison	Self-reported adherence	Viral load	Sexual risk-taking intentions
		Contrast (95% CI)	**OR (95% CI)**	**Contrast (95% CI)**
12-months	**Intervention vs. Control**	-0.02 (-0.31, 0.27)	0.94 (0.45, 1.99)	0.16 (-1.41, 0.47)
24-months	**Intervention vs. Control**	**-0.28 (-0.55, -0.004)**	0.71 (0.39, 1.31)	-0.36 (-1.08, 0.36)
36-months	**Intervention vs. Control**	-0.02 (-0.26, 0.21)	0.57 (0.29, 1.11)	-0.47 (-1.11, 0.17)
48-months	**Intervention vs. Control**	-0.12 (-0.62, 0.38)	0.76 (0.37, 1.55)	-0.29 (-0.91, 0.32)
No. of participants		702	702	702
No. of observations		3351	3269	3309

Bolded numbers represent significant values. For continuous self-reported adherence and sexual risk-taking intentions outcomes, negative values indicate lower estimates for the intervention group compared to controls, while positive values indicate higher estimates for the intervention group compared to controls at each time point. Self-reported adherence is measured by the mean number of days medications were missed; thus lower values indicated better adherence. OR = odds ratio (exponentiated coefficient) are reported for the binary viral load outcome

Effect of the family economic intervention on ALWHIV's perception of physical health, education and economic outcomes (Secondary outcomes)

For self-rated physical health, only significant effects for time were observed overall ($\chi2(4) = 68.89$, $p < 0.0001$). There were no significant effects for group and the group-by-time interaction (**Table S4, Figure S5**). Moreover, no significant differences for physical health were observed between the intervention and control group at each time point (Table 2). However, for the education and economic outcomes, we observed significant main effects for time, group, and group-by-time interactions (**Table S4**). For school enrolment, there was a significant main effect for time, $\chi2(4) = 134.42$, $p < 0.0001$, and for group, $\chi2(1) = 5.84$,

Table 2 Comparisons of study group means within each time point for secondary outcomes (group-within-time simple effects)

Time point	Comparison	Self-rated physical health	School enrolment	Currently have savings	Amount of savings
		Contrast (95% CI)	**OR (95% CI)**	**OR (95% CI)**	**Contrast (95% CI)**
12-months	**Intervention vs. Control**	0.05 (-0.13, 0.22)	2.47 (0.94, 6.21)	**2.68 (1.61, 4.46)**	**0.77 (0.37, 1.18)**
24-months	**Intervention vs. Control**	0.03 (-0.14, 0.19)	**2.52 (1.11, 5.75)**	**3.77 (1.84, 7.69)**	**0.58 (0.24, 0.92)**
36-months	**Intervention vs. Control**	0.06 (-0.10, 0.22)	**4.66 (2.23, 9.74)**	**1.67 (1.01, 2.75)**	**0.84 (0.40, 1.29)**
48-months	**Intervention vs. Control**	0.09 (-0.03, 0.22)	**2.18 (1.30, 3.66)**	**2.03 (1.29, 3.18)**	**0.40 (0.10, 0.70)**
No. of participants		702	701	702	539
No. of observations		3353	3333	3353	1357

Bolded numbers represent significant values. For continuous self-rated physical health and savings amount outcomes, negative values indicate lower estimates for the intervention group compared to controls, while positive values indicate higher estimates for the intervention group compared to controls at each time point. OR = odds ratio (exponentiated coefficient) are reported for the binary school enrolment and having savings outcomes.

p = 0.0157. There was also a significant group-by-time interaction, $\chi2(4) = 9.75$, p = 0.0449 (**Table S4**). ALWHIV in the intervention group had 2.52, 4.66, and 2.18 times greater odds of being enrolled in school than ALWHIV in control group at 24-, 36-, and 48-months, respectively (Table 2). For the savings outcome, there were significant omnibus effects for time, $\chi2(4) = 104.36$, p < 0.0001, for group, $\chi2(1) = 11.05$, p = 0.0009 (**Table S4**), and the group-by-time interaction, $\chi2(4) = 29.95$, p < 0.0001. ALWHIV had 2.68, 3.77, 1.67 and 2.03 greater odds of saving than controls at all post-baseline time points (Table 2). For the amount of savings, there was a significant main effect for time, $\chi2(4) = 1857.09$, p < 0.0001, group $\chi2(1) = 12.19$, p = 0.0005, and there was also a significant group-by-time interaction, $\chi2(4) = 12.49$, p = 0.0141 (**Table S4**). At each post-baseline time point, ALWHIV in the intervention group had more savings than controls (Table 2).

Discussion

ALWHIV in low-resource settings face numerous poverty-related challenges that can affect their physical health, educational, social and economic well-being. It is imperative to develop responsive, multifaceted, family-based economic interventions that can promote long-term improvements in physical health, behavioral and socio-economic outcomes beyond what is currently achieved by the usual care provided for ALWHIV. We examined the long-term (48 months) impact of the FEE-intervention implemented during the Suubi + Adherence study on our primary (i.e., ART adherence and viral suppression, sexual risk-taking behavior) and secondary outcomes (self-rated physical health, educational and economic) among ALWHIV in Uganda. Despite a strong intervention design, we did not find significant differences between the intervention and control groups for primary outcomes, viral load, and sexual risk-taking intentions, and the secondary outcome, perception of physical health, among the entire sample. We found some evidence for significantly better adherence among ALWHIV in the intervention group but this was only observed at 24 months. However, the statistically significant time main effects and margins plot show that both groups improved in parallel over time compared to baseline, indicating that ALWHIV in both groups benefitted from being in the study; both groups reported significantly better adherence, less risky sexual risk-taking intentions, had improved viral load, and improved physical health over time.

Evaluating health outcomes for ALWHIV is critical because when they are virally suppressed, they are far less likely to spread the virus (20), and more likely to live healthier lives (21), especially during adolescence when they form intimate relationships. Furthermore, our findings reinforce the need for ongoing VL monitoring both as a health outcome and as a partial proxy measure of adherence to ensure that the prescribed ART is working properly to suppress viral replication and, if necessary, to adjust the treatment accordingly (22). Although we did not observe significant differences in proportions with detectable viral load between the two study groups overall, a previous analysis among a sub-sample of ALWHIV with detectable viral loads at baseline from the same study revealed that participants in the FEE intervention group had significantly improved viral load over time compared to those in the control condition (23).

Contrastingly, for three of our secondary outcomes, we observed differential improvement across groups in all outcomes. ALWHIV in the intervention group were more likely to be enrolled in school than controls from 24-months onwards, be more likely to save, and had higher savings compared to the control group at all post-baseline time points. Educational attainment influences individuals' future occupational status, potential earnings, income and wealth (24), with persons of higher socio-economic status experiencing better health than persons of lower socio-economic status (25). For ALWHIV, financial challenges are a substantial barrier to school enrolment (26). Indeed for ALWHIV, schools play an important role in: providing the much needed HIV/AIDS-related education; providing psycho-social support and counselling; assisting with providing access to nutritional, health, and medical services; and building partnerships with local communities and health and welfare agencies which all work together to reduce risk-taking behaviors among adolescents and improve health and well-being of ALWHIV (27). Poverty, unemployment and lack of food are major barriers to adherence among ALWHIV (28). Hence, the improved school enrolment and economic outcomes observed in this study can provide a form of financial security for ALWHIV to afford meals, transportation, and costs associated with accessing medical care, and create opportunities for greater wealth, contributing to improved overall health and wellbeing among ALWHIV in the long term.

Our findings add to the growing body of research which show that FEE-interventions that address poverty-related barriers via inclusion of a savings incentive can have positive effects on the socio-economic wellbeing among ALWHIV (11, 12, 29, 30). In this study, the savings incentive was provided for only 24 months. However, the lasting effect on respondents' savings culture even after the incentives ended at 24 months following intervention initiation is consistent with behavior observed among adolescents orphaned by AIDS in Uganda who received a similar FEE-intervention (31). Higher school enrolment may be an indirect benefit

realized among the intervention group given their improved financial well-being from the savings accounts which increased families' ability to afford school tuition since Free Universal Primary Education ends after grade seven of primary school in Uganda. Although Universal Secondary Education (USE) has been introduced in Uganda, financial barriers in the form of high non-tuition costs associated with secondary education such as scholastic materials, uniforms, and meals, are prevalent and prohibit many ALWHIV from enrolling and completing secondary education (26). Having limited economic assets and economic instability increases one's likelihood of dropping out of school to find employment and engaging in risky behaviors, including unsafe sexual behaviors (32). Hence, providing small investments in long-term goals can contribute to improved social outcomes for ALWHIV in low-resource settings, opening up opportunities for ALWHIV to be better educated, and ultimately realize a higher earning potential, which can contribute to improved overall health and well-being.

However, there were some limitations to this study. First, some of the self-reported measures may be subject to social desirability bias. For example, self-reported adherence may be over-reported. Similarly, sexual risk-taking attitudes was used as a proxy for actual sexual activity and this may have been underreported. However, previous research among youths in SSA indicate that sexual risk-taking intentions are a good indicator of actual sexual behavior (33). Second, the findings of no significant differences in adherence (except at 24 months), viral load, sexual risk-taking intentions, and self-rated physical health between study groups could also be explained by the 'Hawthorne effect'. The Hawthorne effect occurs when participation in a study causes behavior change during the study itself (34). For example in the behavioral HIV Prevention Trial Network conducted in South Africa, study participation influenced school enrolment (during the trial itself) among participants in both study arms, causing no significant differences in school enrolment to be observed (Hawthorne effect) (35). In the Suubi + Adherence study, participants in both study conditions were aware of the objectives of the study to improve treatment adherence and improve overall health among ALWHIV. ALWHIV in the control group received six sessions of enhanced adherence counseling, during which they reviewed HIV, ART, ART resistance and adherence. They also received materials to support family communication about HIV and adherence. ALWHIV in the intervention group received the economic intervention in addition to the enhanced adherence counselling. Hence, during the Suubi + Adherence study, both groups may have positively adapted their adherence and risk-taking intentions to align with perceived expectations. They could also have been more motivated to adhere, have less risky intentions and choose behaviors that positively influenced their health, a possible explanation for the null overall study group effect on the adherence (except at 24-months), viral load, physical health and sexual risk-taking intentions outcomes. Lastly, the inclusion criteria for the Suubi + Adherence study required ALWHIV to be aged 10–16 at baseline, prescribed ART medication, and receiving HIV care and treatment at one of participating clinics. As such, our findings are not generalizable to older age groups, those who are not aware of HIV status and not enrolled in care.

Conclusions

This Family Economic Empowerment intervention comprised child development savings accounts, training on financial management and starting a business, in addition to mentorship. It contributes to the evidence base of strategies that can innovatively improve adherence, alleviate economic hardships and increase educational attainment of ALWHIV in resource-limited settings. Therefore, the need for further research on interventions that can achieve sustained improvements in all health-related domains above what is achieved in usual care are recommended to bolster available evidence on the long-term effects of these interventions across a range of outcomes. Further research should also explore whether school enrolment and savings act as mediators or moderators of the effect of the intervention on health outcomes.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10461-022-03637-1.

Acknowledgements We are extremely grateful to: the staff at the International Center for Child Health and Development for monitoring and implementing the study; the 39 health centers; participating children and their caregiving families; Reach the Youth and Masaka Diocese, our implementing partners.

Authors' contributions F.M. Ssewamala conceptualized and designed the Suubi + Adherence study on which this article is based, obtained funding for the Suubi + Adherence study, and supervised the writing. R. Brathwaite performed the analysis, and wrote the first draft of manuscript. T. B. Neilands supervised the analysis as the lead statistician on the Suubi + Adherence study. M. Mutumba, W. Byansi, P. Nabunya, G. Nakigozi, and F. Makumbi contributed to writing and reviewing drafts of the manuscript. C. Damulira was the field data manager, and F. Namuwonge was the study coordinator for data collection for the Suubi + Adherence study. C.A. Mellins, and M.M. Mckay contributed to the design of the original study and the measures collected.

Funding The Suubi + Adherence study was funded by the Eunice Kennedy Shriver National Institutes of Child Health and Human Development (NICHD) (Grant #1R01HD074949–01, PI: Fred M. Ssewamala). Research reported in this publication was supported by the NIMH award number R25 MH118935. The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manu-

script; and decision to submit the manuscript for publication.

Availability of data and material (data transparency)

Code Availability (software application or custom code)

Declarations

Conflicts of interest/Competing interests The authors declare they have no competing interests.

Ethics Approval and Informed Consent Caregivers provided written consent and adolescents provided voluntary written assent for the adolescent to participate in the study. The recruitment and interaction with human subjects and their health information were completed according to protocols reviewed and approved by Columbia University (Protocol AAAK3852), the Makerere University School of Public Health (Protocol 210) and the Uganda National Council for Science and Technology (Protocol SS 2969) Ethics and Institutional Review Boards.

Consent for publication Not applicable.

References

1. UNICEF. Adolescent HIV, Prevention. HIV in adolescents: UNICEF; 2020 [Available from: https://data.unicef.org/topic/hivaids/adolescents-young-people/.
2. UPHIA. UGANDA POPULATION-BASED HIV IMPACT ASSESSMENT. UPHIA 2016–2017. Uganda; 2018.
3. UNAIDS. Country factsheets. Uganda 2019: HIV and AIDS Estimates 2019 [Available from: https://www.unaids.org/en/regionscountries/countries/uganda.
4. Tuller DM, Bangsberg DR, Senkungu J, Ware NC, Emenyonu N, Weiser SD. Transportation costs impede sustained adherence and access to HAART in a clinic population in southwestern Uganda: a qualitative study. AIDS Behav. 2010;14(4):778–84.
5. Au JT, Kayitenkore K, Shutes E, Karita E, Peters PJ, Tichacek A, et al. Access to adequate nutrition is a major potential obstacle to antiretroviral adherence among HIV-infected individuals in Rwanda. Aids. 2006;20(16):2116–8.
6. Simoni JM, Amico KR, Pearson CR, Malow R. Strategies for promoting adherence to antiretroviral therapy: a review of the literature. Curr Infect Dis Rep. 2008;10(6):515–21.
7. Haberer J, Mellins C. Pediatric adherence to HIV antiretroviral therapy. Curr HIV/AIDS Rep. 2009;6(4):194–200.
8. Pellowski JA, Kalichman SC, Matthews KA, Adler N. A pandemic of the poor: social disadvantage and the U.S. HIV epidemic. Am Psychol. 2013;68(4):197–209.
9. Marais BJ, Esser M, Godwin S, Rabie H, Cotton MF. Poverty and Human Immunodeficiency Virus in Children. Ann N Y Acad Sci. 2008;1136(1):21–7.
10. Ssewamala FM, Byansi W, Bahar OS, Nabunya P, Neilands TB, Mellins C, et al. Suubi + Adherence study protocol: A family economic empowerment intervention addressing HIV treatment adherence for perinatally infected adolescents. Contemp Clin Trials Commun. 2019;16:100463.
11. Sun S, Nabunya P, Byansi W, Bahar OS, Damulira C, Neilands TB, et al. Access and utilization of financial services among poor HIV-impacted children and families in Uganda. Child Youth Serv Rev. 2020;109:104730.
12. Cavazos-Rehg P, Byansi W, Xu C, Nabunya P, Sensoy Bahar O, Borodovsky J, et al. The Impact of a Family-Based Economic Intervention on the Mental Health of HIV-Infected Adolescents in Uganda: Results From Suubi + Adherence. J Adolesc health: official publication Soc Adolesc Med. 2021;68(4):742–9.
13. Government of Uganda. HIV and AIDS Uganda country progress report 2014. Kampala: Uganda AIDS Commission; 2014.
14. Uganda AIDS, Commission. National HIV and AIDS Strategic Plan 2015/2016–2019/2020. Kampala; 2015. Uganda.
15. Uganda AIDS, Commission. The Uganda HIV and AIDS Country Progress Report July 2015-June2016. UgandaNovember: Kampala; 2016.
16. Sherraden M. Assets and the poor: A new American welfare policy. New York: ME Sharpe; 1991. p. 344.
17. Ssewamala FM, Neilands TB, Waldfogel J, Ismayilova L. The Impact of a Comprehensive Microfinance Intervention on Depression Levels of AIDS-Orphaned Children in Uganda. J Adolesc Health. 2012;50(4):346–52.
18. World Health Organization. Chapter 7: Clinical guidance across the continuum of care: antiretroviral therapy. In: Consolidated guidelines on the use of antiretrovial drugs for treating and preventing HIV infection Recommendations for a public health approach. Geneva Switzerland: World Health Organization; 2013.
19. Shato T, Nabunya P, Byansi W, Nwaozuru U, Okumu M, Mutumba M, et al. Family Economic Empowerment, Family Social Support, and Sexual Risk-Taking Behaviors Among Adolescents Living With HIV in Uganda: The Suubi + Adherence Study. Journal of Adolescent Health. 2021;69(3):406–13.
20. Ross-Degnan D, Pierre-Jacques M, Zhang F, Tadeg H, Gitau L, Ntaganira J, et al. Measuring adherence to antiretroviral treatment in resource-poor settings: The clinical validity of key indicators. BMC Health Serv Res. 2010;10(1):42.
21. Mills EJ, Nachega JB, Buchan I, Orbinski J, Attaran A, Singh S, et al. Adherence to antiretroviral therapy in sub-Saharan Africa and North America: a meta-analysis. JAMA. 2006;296(6):679–90.
22. de Silva TI, Peng Y, Leligdowicz A, Zaidi I, Li L, Griffin H, et al. Correlates of T-cell–mediated viral control and phenotype of CD8 + T cells in HIV-2, a naturally contained human retroviral infection. Blood. 2013;121(21):4330–9.
23. Ssewamala FM, Dvalishvili D, Mellins CA, Geng EH, Makumbi F, Neilands TB, et al. The long-term effects of a family based economic empowerment intervention (Suubi + Adherence) on suppression of HIV viral loads among adolescents living with HIV in southern Uganda: Findings from 5-year cluster randomized trial. PLoS ONE. 2020;15(2):e0228370.
24. Mirowsky J, Ross CE. Education, social status, and health. Routledge; 2017.
25. Marmot M. Social determinants of health inequalities. The Lancet. 2005;365(9464):1099–104.
26. Kimera E, Vindevogel S, Kintu MJ, Rubaihayo J, De Maeyer J, Reynaert D, et al. Experiences and perceptions of youth living with HIV in Western Uganda on school attendance: barriers and facilitators. BMC Public Health. 2020;20(1):79.
27. UNESCO. HIV & AIDS and Supportive Learning Environments. Good Policy and Practice in HIV & AIDS in Education (booklet series). Paris; 2008.
28. Moomba K, Van Wyk B. Social and economic barriers to adherence among patients at Livingstone General Hospital in Zambia. Afr J Prim Health Care Fam Med. 2019;11(1):e1–6.
29. Karimli L, Ssewamala FM, Neilands TB. Poor Families Striving to Save in Matched Children's Savings Accounts: Findings from a Randomized Experimental Design in Uganda. Social Service Review. 2014;88(4):658–94.
30. Chowa G. Impacts of financial inclusion on youth development: Findings from the Ghana YouthSave experiment. 2015.
31. Ssewamala FM, Shu-Huah Wang J, Brathwaite R, Sun S, Mayo-Wilson LJ, Neilands TB, et al. Impact of a Family Economic

Intervention (Bridges) on Health Functioning of Adolescents Orphaned by HIV/AIDS: A 5-Year (2012–2017) Cluster Randomized Controlled Trial in Uganda. Am J Public Health. 2021 Mar;111(3):504–513.
32. Hallman K. Socioeconomic disadvantage and unsafe sexual behaviors among young women and men in South Africa. 2004.
33. Protogerou C, Flisher AJ, Aarø LE, Mathews C. The theory of planned behaviour as a framework for predicting sexual risk behaviour in sub-Saharan African youth: A critical review. J Child Adolesc Mental Health. 2012;24(1):15–35.
34. McCarney R, Warner J, Iliffe S, Van Haselen R, Griffin M, Fisher P. The Hawthorne Effect: a randomised, controlled trial. BMC Med Res Methodol. 2007;7(1):1–8.
35. Rosenberg M, Pettifor A, Twine R, Hughes JP, Gomez-Olive FX, Wagner RG, et al. Evidence for sample selection effect and Hawthorne effect in behavioural HIV prevention trial among young women in a rural South African community. BMJ Open. 2018;8(1):e019167.